Chapter 10
Ice Jam Flooding in the United States

10-1. General

Flooding and flood-related events cause greater damage and more fatalities than any other natural disaster. About 80 percent of all presidential disaster declarations are the result of flooding (Federal Emergency Management Agency 1992a). Flood damages averaged $3.3 billion and flood-related fatalities averaged about 100 annually over a recent 10-year period (U.S. Army 1993, 1994). The most common type of flood is the result of a major rainfall or snowmelt. A second type of flood happens suddenly, as in the case of dam failures or intense rainfall that generates a flash flood. A third category of flood results from an ice or debris jam. Flood stages during an ice jam (Figure 10-1) can increase more rapidly and attain higher levels than those associated with open-water conditions. Ice jam flooding may take place outside the regulatory floodplain, often when the river flow would not otherwise cause problems. Many laws and regulations have been developed to reduce national vulnerability to flooding. Most American communities have floodplain regulations designed to prevent future development in areas subject to conventional open-water flooding. Some communities are protected by structural controls, such as dikes, levees, and flood control dams. Mitigation measures specifically designed to protect against ice jam flooding are used less commonly.

10-2. Ice Jam Flooding

In many northern regions, ice covers the rivers and lakes annually. The yearly freezeup and breakup commonly take place without major flooding. However, some communities face serious ice jam threats

Figure 10-1. Ice jam flooding

every year, while others experience ice-jam-induced flooding at random intervals. The former often have developed emergency plans to deal with ice jam problems, but the latter are often ill-prepared to cope with a jam. In a 1992 survey, Corps District and Division offices reported ice jam problems in 36 states, primarily in the northern tier of the United States (Figure 10-2). However, even mountainous regions as far south as New Mexico and Arizona experience river ice. Of the 36 states, 63 percent reported that ice jams occur frequently, and 75 percent rated ice jams as being serious to very serious (White 1992). Ice jams affect the major navigable inland waterways of the United States, including the Great Lakes. A study conducted in Maine, New Hampshire, and Vermont identified over 200 small towns and cities that reported ice jam flooding over a 10-year period (U.S. Army 1980). In March 1992 alone, 62 towns in New Hampshire and Vermont reported ice jam flooding problems after two rainfall events. Table 10-1 lists some of the major ice jams recently recorded.

Table 10-1
Recent Major Ice Jams in the United States

Place	Date	Type (Damages)
Montpelier, Vermont	March 1992	Breakup ($5 million)
Allagash, Maine	April 1991	Breakup ($14 million)
Salmon, Idaho	February 1984	Freezeup ($1.8 million)
Port Jervis, New York/ Matamoras, Pennsylvania	February 1981	Breakup ($14.5 million)
Mississippi River/ Missouri River Confluence	December 1989	Breakup (>$20 million)

a. Characteristics of ice jams and ice jam flooding. Because ice jam floods are less common and more poorly documented than open-water floods, it is more difficult to characterize these events compared to open-water flooding. In addition, because of the complex processes involved in the formation and progression of ice jams and the highly site-specific nature of these jams, these events are more difficult to predict than open-water flooding. The rates of water level rise can vary from feet per minute to feet per hour during ice jam flooding. In some instances, communities have many hours of lead time between the time an ice jam forms and the start of flooding. In other cases, the lead time is as little as 1 hour. Although the actual time of flooding may be short compared to open-water floods lasting days to weeks, significant damage can result. The winter weather conditions often prevalent when ice jams occur also add to the risks and damages associated with ice jam flooding.

b. Example from Montpelier, Vermont, 1992. In March 1992, an ice jam developed at 0700 in Montpelier, Vermont. By 0800 the downtown area was flooded (Figure 10-3). During the next 11 hours, the business district was covered with an average of 1.2 to 1.5 meters (4 to 5 feet) of water. The flood happened so quickly that there was not sufficient time to warn residents so that they could protect their property and possessions. Even after water levels dropped, damage related to the flooding continued as cold weather caused freezing of wet objects. Damages of less than 1 day were estimated at $5 million (Federal Emergency Management Agency 1992b).

10-3. Ice Jam Flood Losses

a. Loss of life. Ice jam flooding is responsible for loss of life, although the number of fatalities in the United States is considerably less than those from open-water flooding. In the last 30 years, at least seven people have died as a result of ice jam flooding. Six of the deaths were attributed to rescue

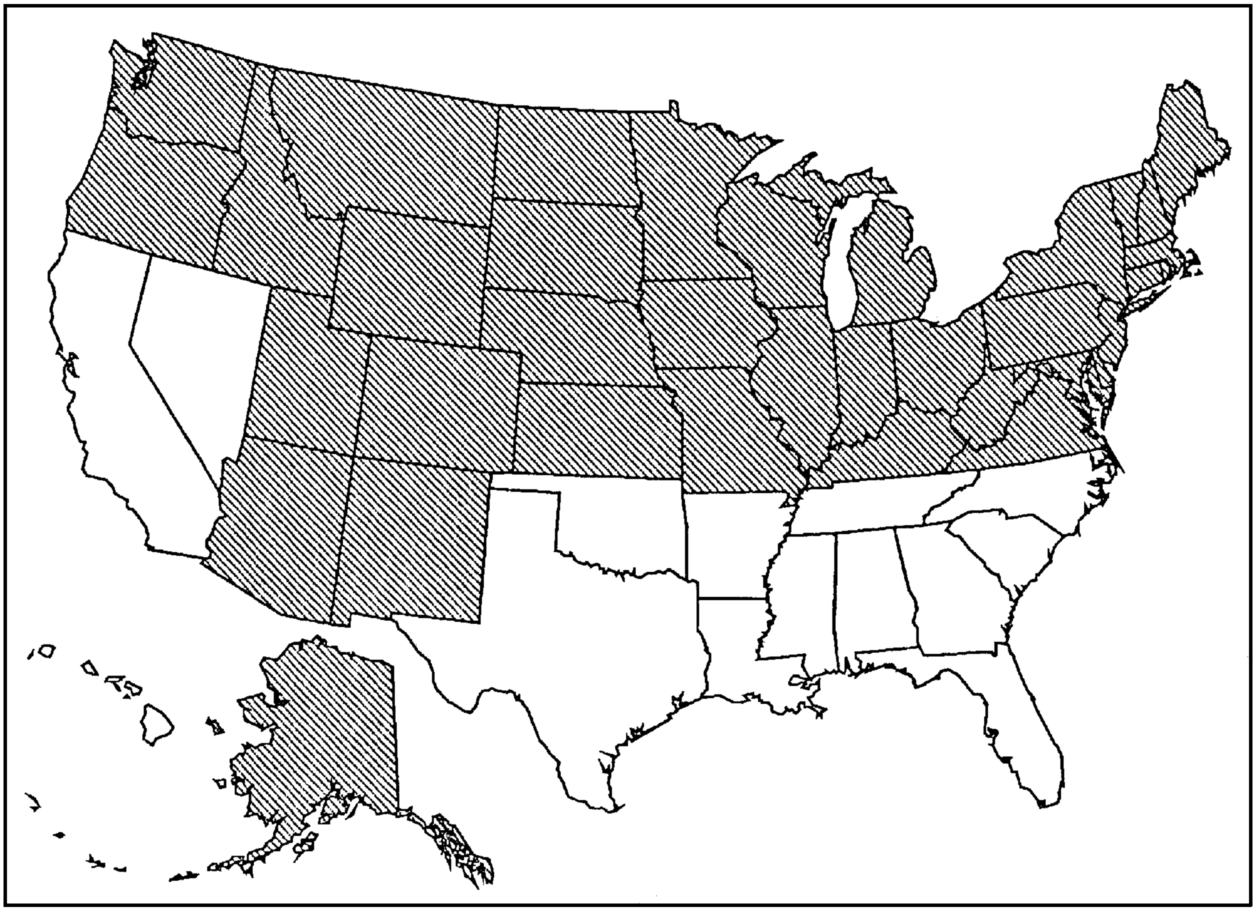

Figure 10-2. Ice jam flooding occurs in shaded states

attempts; the other death occurred from injuries sustained when a basement wall collapsed because of pressure from flood waters and ice.

b. Dollar costs. Ice jams in the United States cause approximately $125 million in damages annually, including an estimated $50 million in personal property damage and $25 million in operation and maintenance costs to Corps navigation, flood control, and channel stabilization structures.

c. Interference with navigation. Ice jams have suspended or delayed commercial navigation, causing adverse economic impacts (Figure 10-4). Although navigational delays are commonly short, they may result in shortages of critical supplies, such as coal and industrial feedstocks, and lead to large costs from the operation of idle vessels (U.S. Army 1981). Ice jams sometimes cause damage to navigation lock gates. Other chapters of this manual provide detailed information on the effects of ice on navigation and the range of strategies to mitigate the effects.

d. Reduced hydropower production. Ice jams also affect hydropower operations, stopping hydropower generation by blocking intakes, causing high tailwater, making reduced discharge necessary, or damaging intake works (Figure 10-5). Lost power revenue attributable to such shutdowns can be substantial.

a. Winooski River

b. Downtown area

Figure 10-3. Views of Montpelier, Vermont, ice jam (March 1992)

Figure 10-4. Towboats and barges in ice

e. Channel erosion and damage to channel training structures. The presence of an ice jam can result in scouring and river bed and bank erosion that may lead to bridge or river bank failure (Figure 10-6). Ice jams can damage stream channels and improvements, so that the overall vulnerability to flooding is increased. Riprap can be undermined or moved out of place. Ice-jam-related damage to river training structures costs millions of dollars each year.

f. Other costs. Indirect costs associated with ice jams include loss of fish and wildlife and their habitat. Scour and erosion associated with ice jams may destroy habitat, such as eagle roosting trees, and mobilize toxic materials buried in sediment. Some scouring may, however, be beneficial to wildlife habitat as well. Shallow, vegetation-choked wetlands may be opened, allowing for fish and waterfowl spawning and brood habitat.

10-4. References

a. Required publications.

None.

b. Related publications.

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Figure 10-5. Jam immediately downstream of power plant, Fox River, near Ottawa, Illinois

Figure 10-6. Bank scour caused by a breakup jam, St. John River, near Allagash, Maine

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